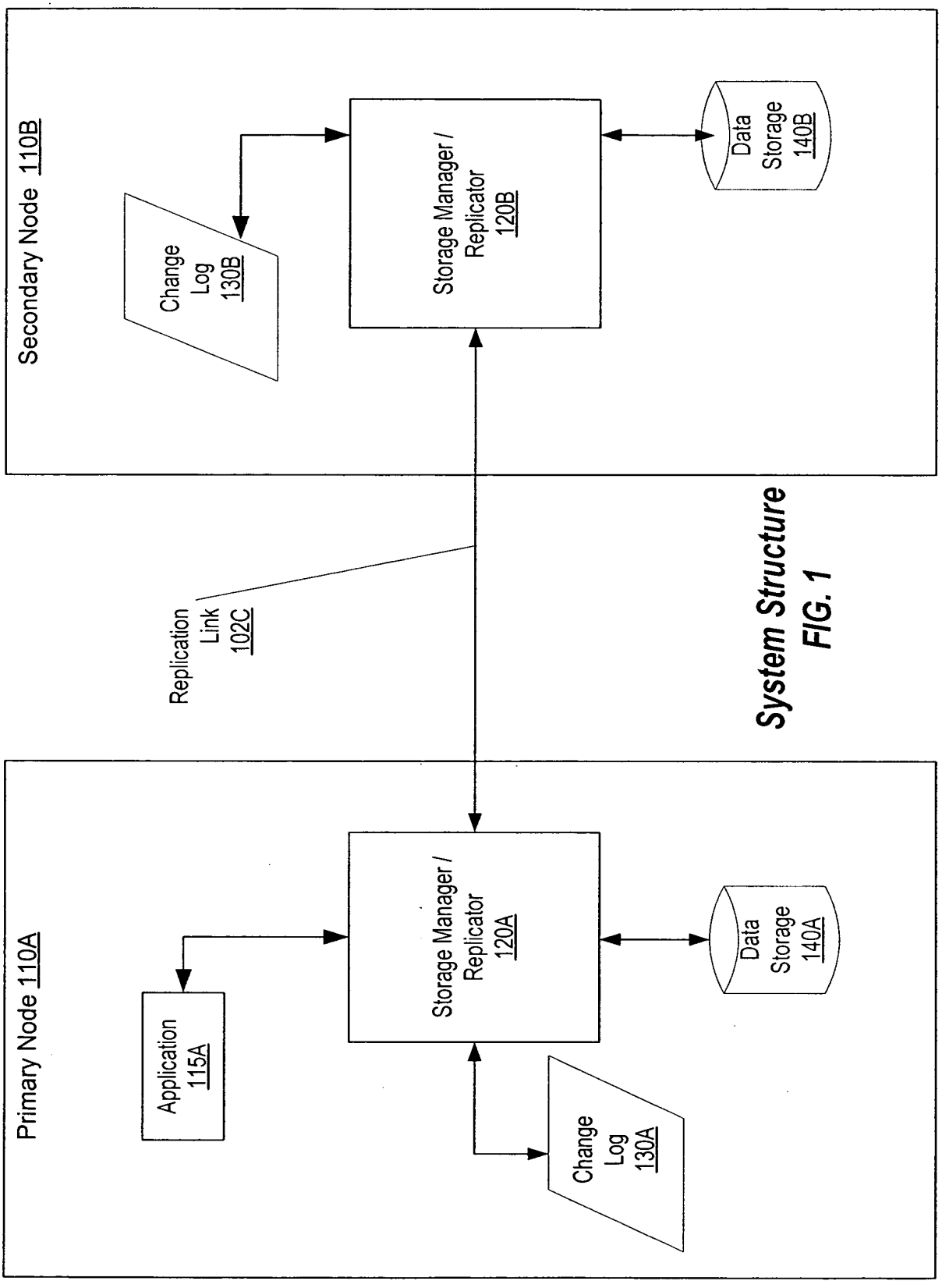

System Structure
FIG. 1

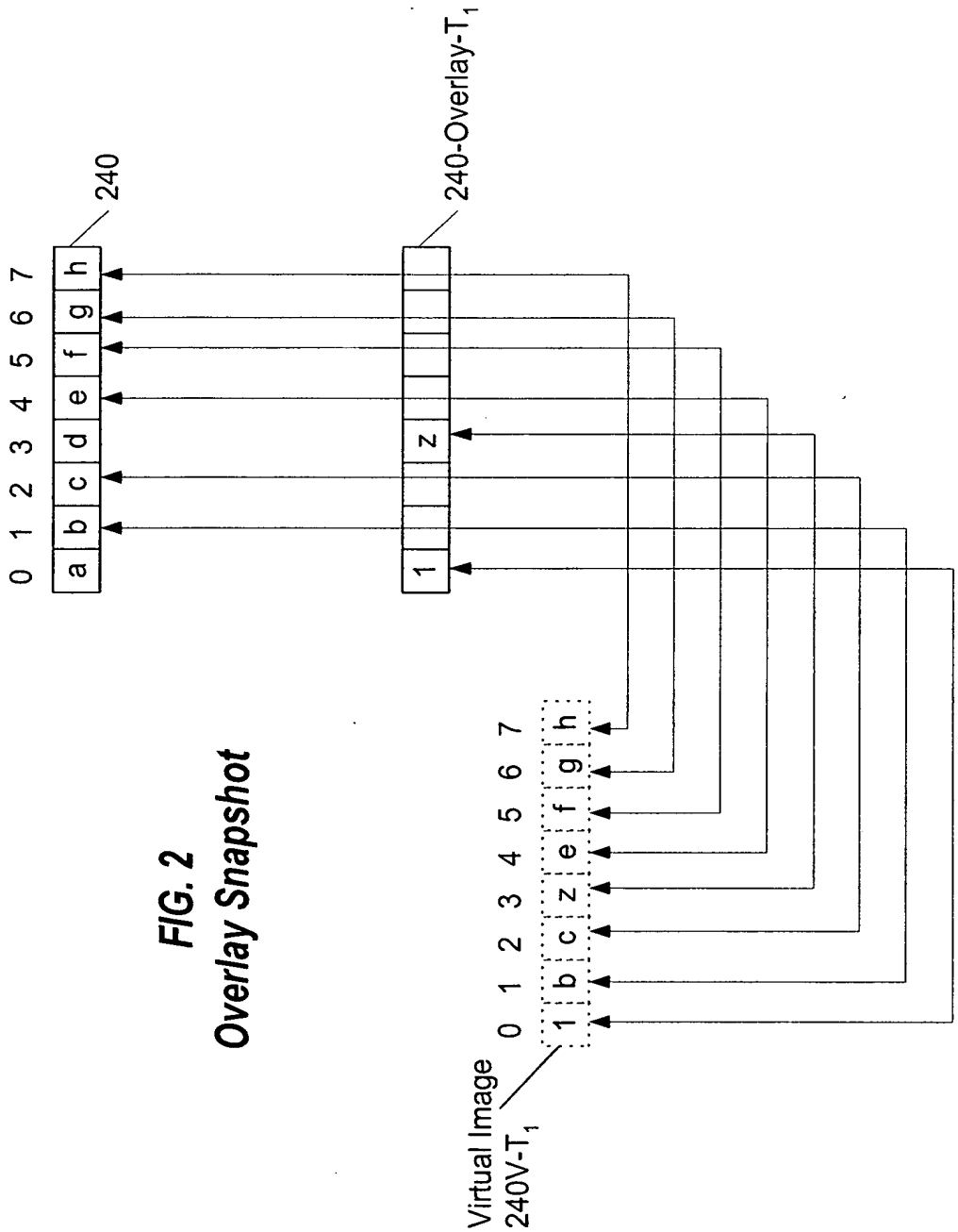

FIG. 2
Overlay Snapshot

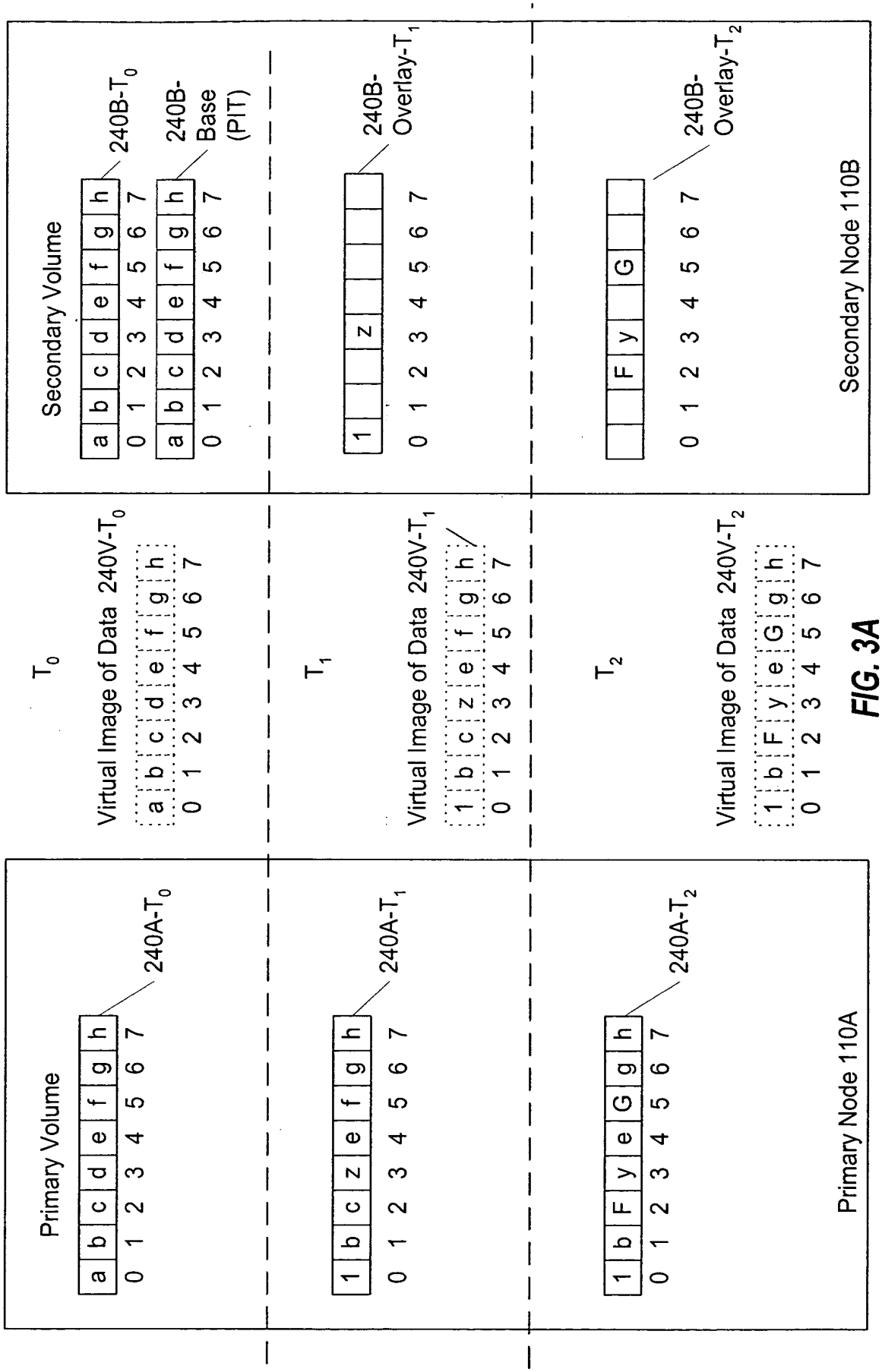
Secondary Volume
240B-T0
240B-Base (PIT)
240B-Overlay-T1
240B-Overlay-T2
Secondary Node 110B
T0
T1
T2
Virtual Image of Data 240V-T0
Virtual Image of Data 240V-T1
Virtual Image of Data 240V-T2
Primary Volume
240A-T0
240A-T1
240A-T2
Primary Node 110A

FIG. 3A

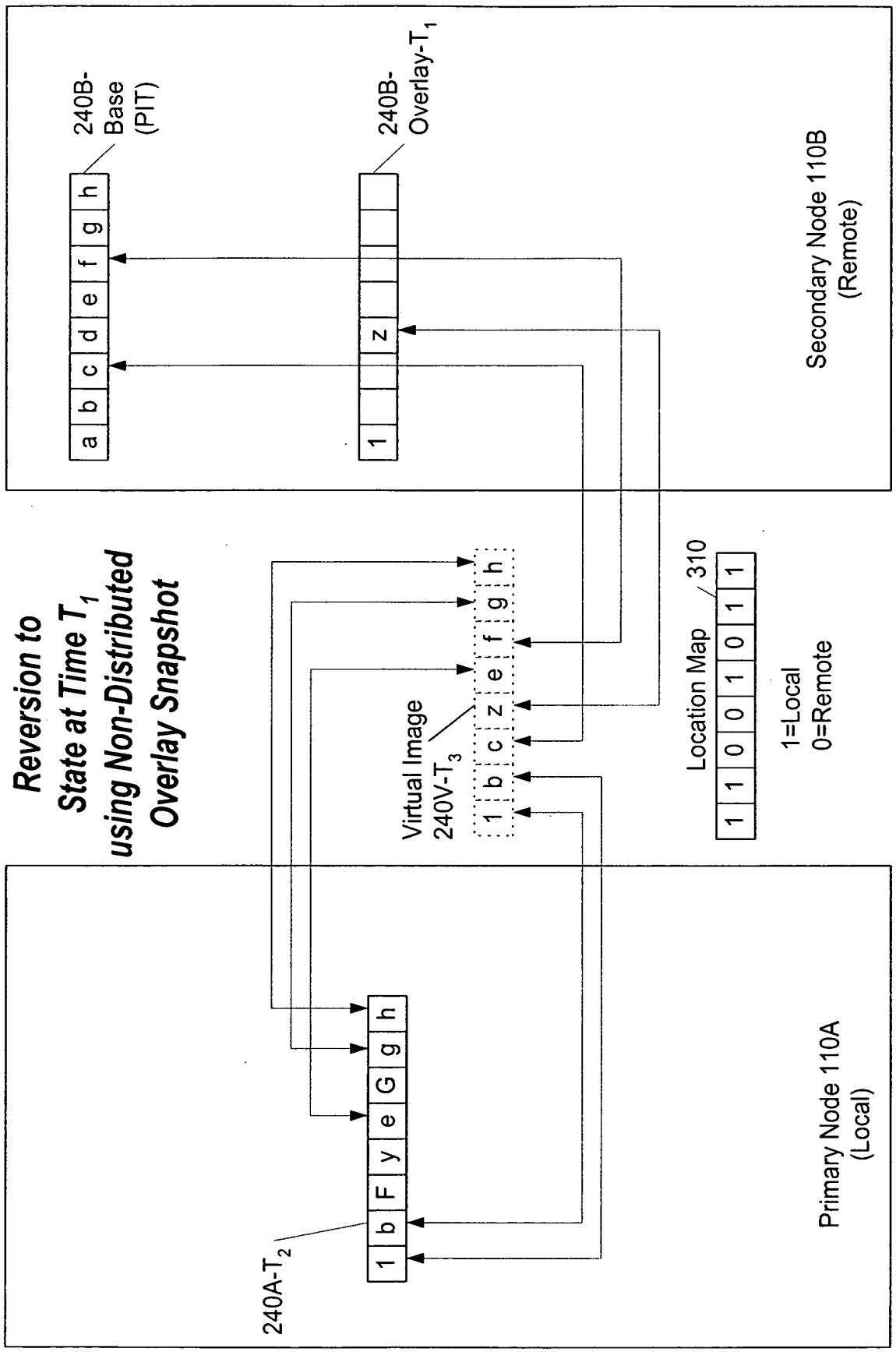

FIG. 3B
Reversion to State at Time T_1 using Non-Distributed Overlay Snapshot

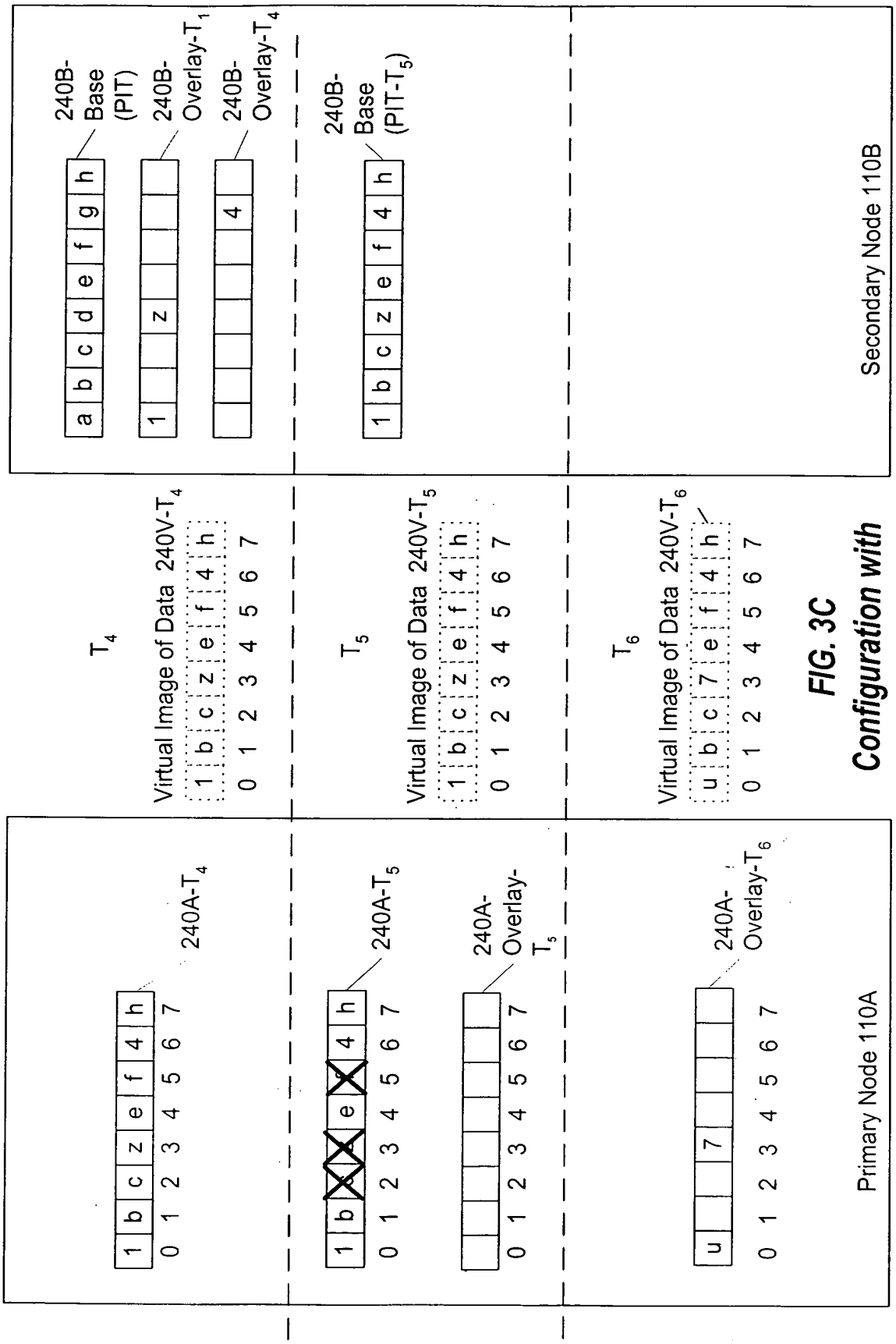

FIG. 3C
Configuration with Distributed Overlay Snapshot

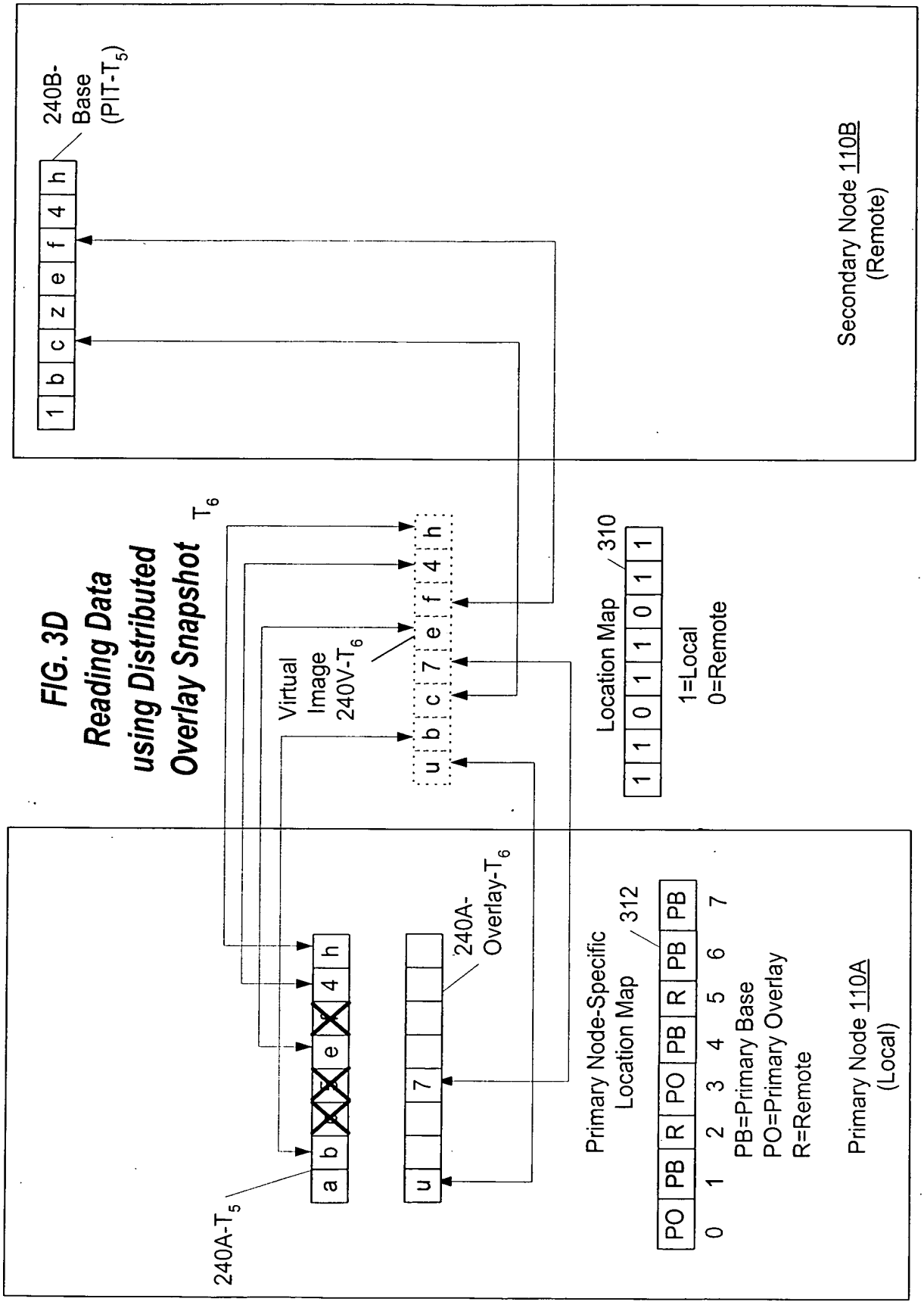
FIG. 3D
Reading Data using Distributed Overlay Snapshot
Secondary Node 110B (Remote)
240B-Base (PIT-T5)
1 b c z e f 4 h
Virtual Image 240V-T6
T6
u b c 7 e f 4 h
Location Map 310
1 1 0 1 1 0 1 1
1=Local
0=Remote
Primary Node 110A (Local)
240A-T5
a b e 4 h
240A-Overlay-T6
u 7
Primary Node-Specific Location Map 312
PO PB R PO PB R PB PB
0 1 2 3 4 5 6 7
PB=Primary Base
PO=Primary Overlay
R=Remote

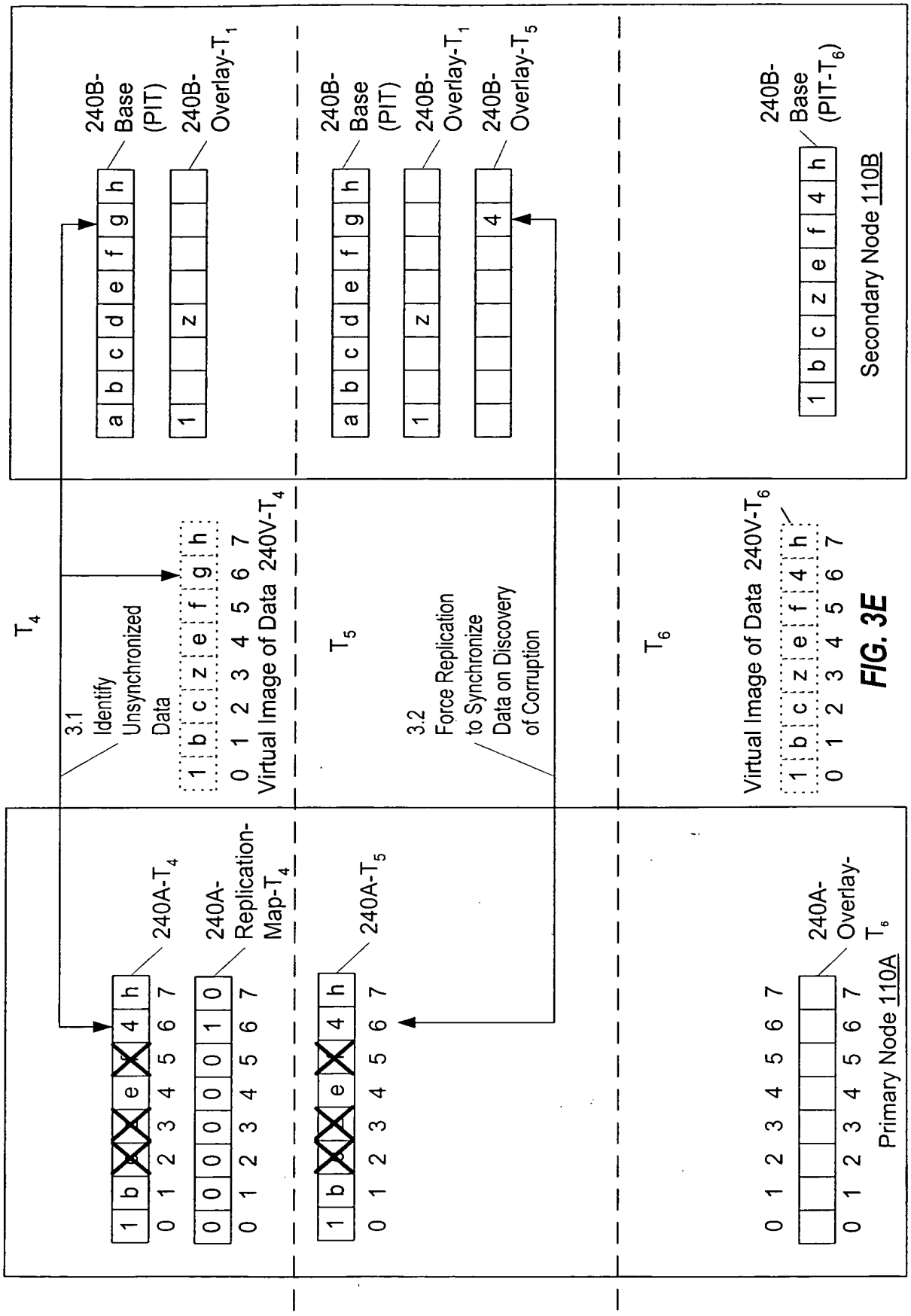
T4
T5
T6
240B-Base (PIT)
240B-Overlay-T1
240B-Overlay-T5
240B-Base (PIT-T6)
Secondary Node 110B
3.1 Identify Unsynchronized Data
3.2 Force Replication to Synchronize Data on Discovery of Corruption
Virtual Image of Data 240V-T4
Virtual Image of Data 240V-T6
240A-T4
240A-Replication-Map-T4
240A-T5
240A-Overlay-T6
Primary Node 110A

FIG. 3E

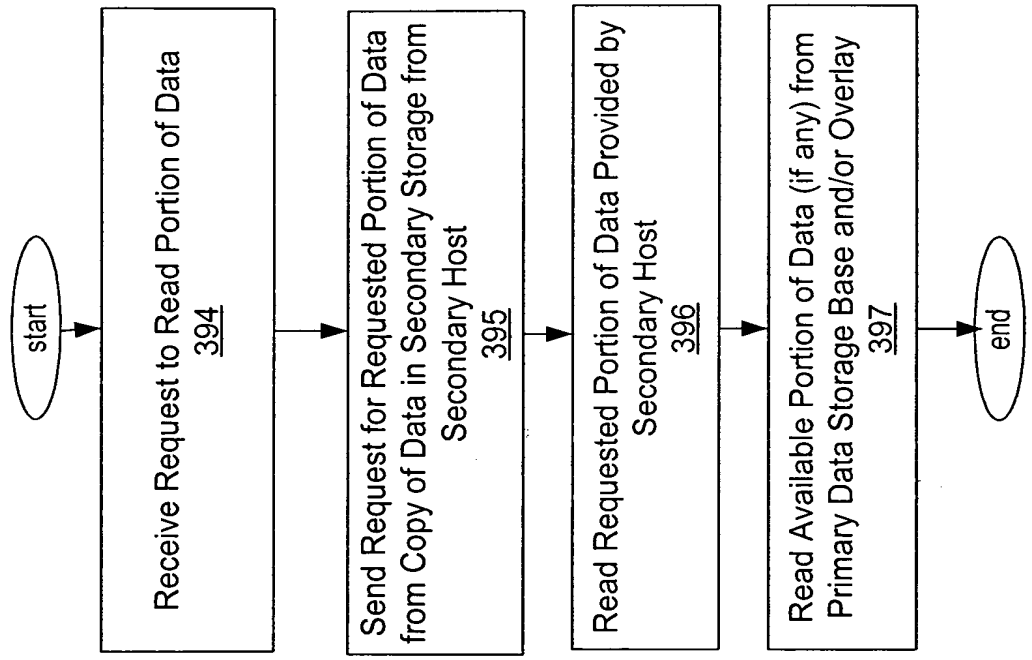
start
Receive Request to Read Portion of Data
394
Send Request for Requested Portion of Data from Copy of Data in Secondary Storage from Secondary Host
395
Read Requested Portion of Data Provided by Secondary Host
396
Read Available Portion of Data (if any) from Primary Data Storage Base and/or Overlay
397
end

FIG. 3G

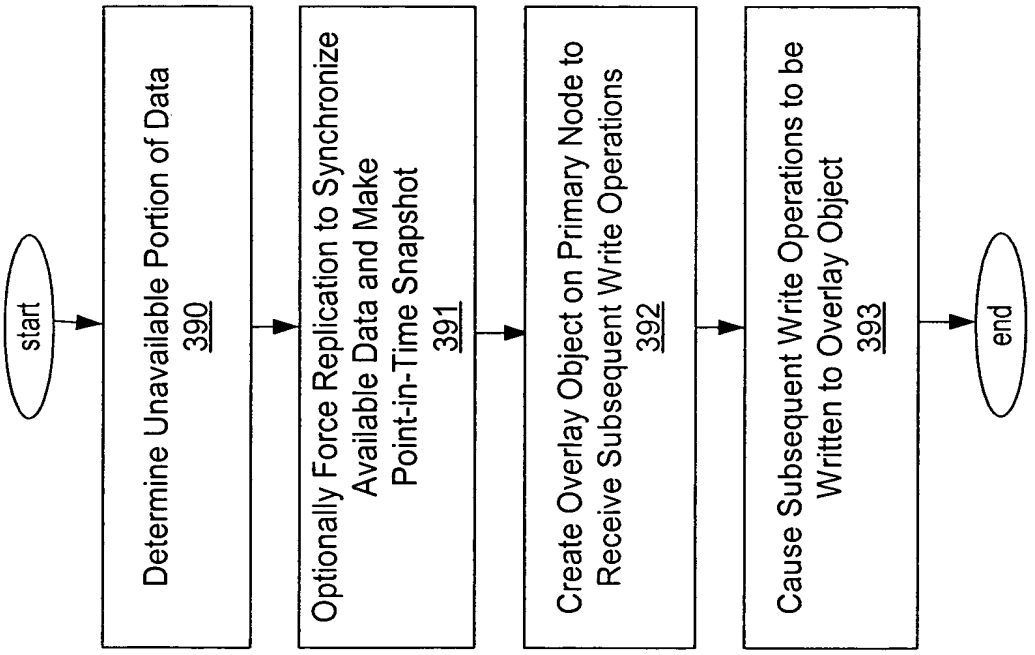
start
Determine Unavailable Portion of Data
390
Optionally Force Replication to Synchronize Available Data and Make Point-in-Time Snapshot
391
Create Overlay Object on Primary Node to Receive Subsequent Write Operations
392
Cause Subsequent Write Operations to be Written to Overlay Object
393
end

FIG. 3F

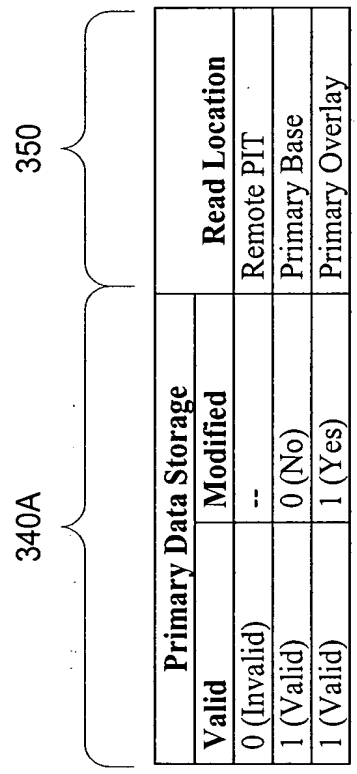
340A
350
Primary Data Storage
Valid
Modified
Read Location
0 (Invalid)
--
Remote PIT
1 (Valid)
0 (No)
Primary Base
1 (Valid)
1 (Yes)
Primary Overlay

FIG. 3H

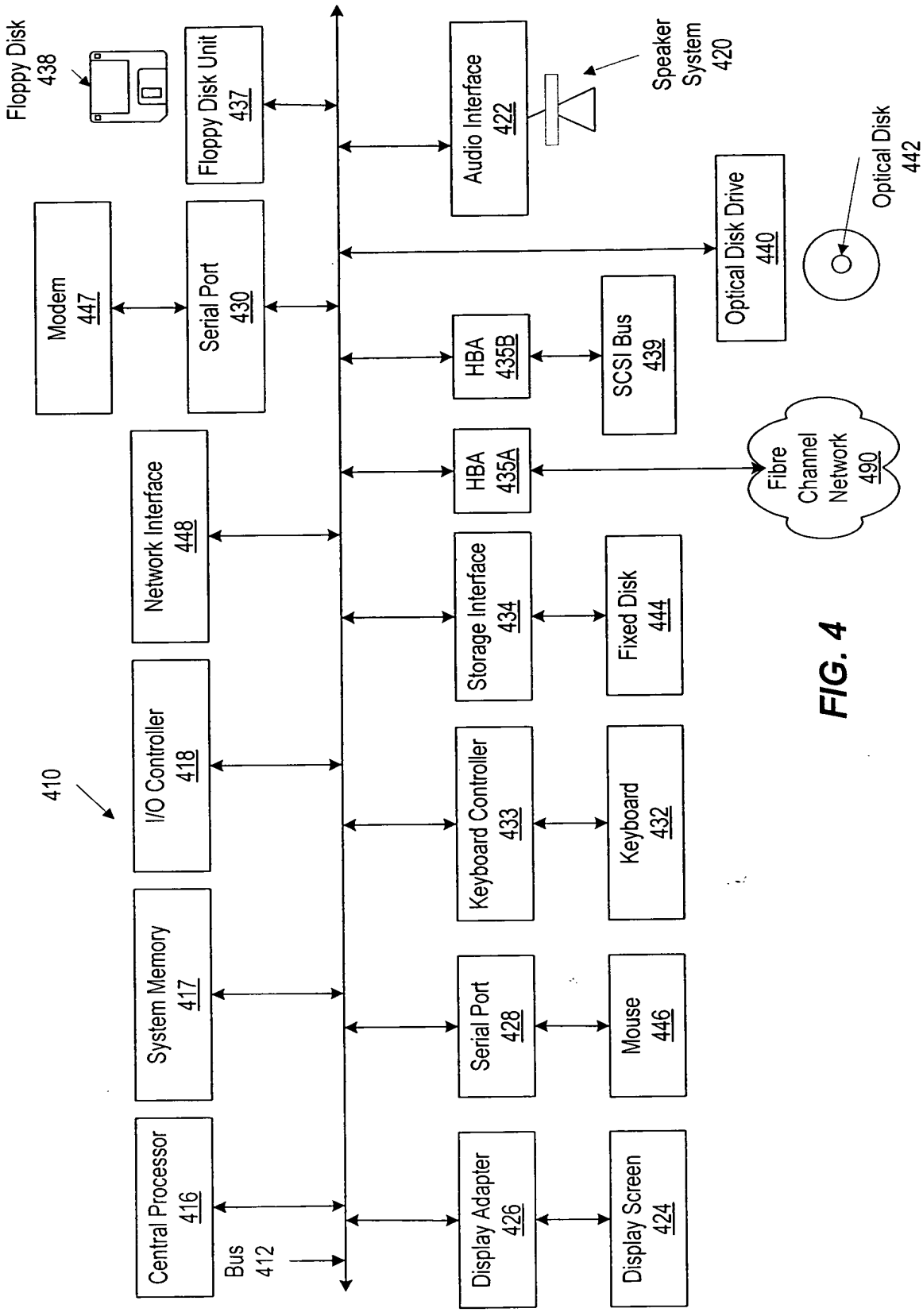
Floppy Disk 438
Floppy Disk Unit 437
Audio Interface 422
Speaker System 420
Modem 447
Serial Port 430
Optical Disk Drive 440
Optical Disk 442
HBA 435B
SCSI Bus 439
HBA 435A
Fibre Channel Network 490
Network Interface 448
Storage Interface 434
Fixed Disk 444
410
I/O Controller 418
Keyboard Controller 433
Keyboard 432
System Memory 417
Serial Port 428
Mouse 446
Central Processor 416
Display Adapter 426
Display Screen 424
Bus 412

FIG. 4